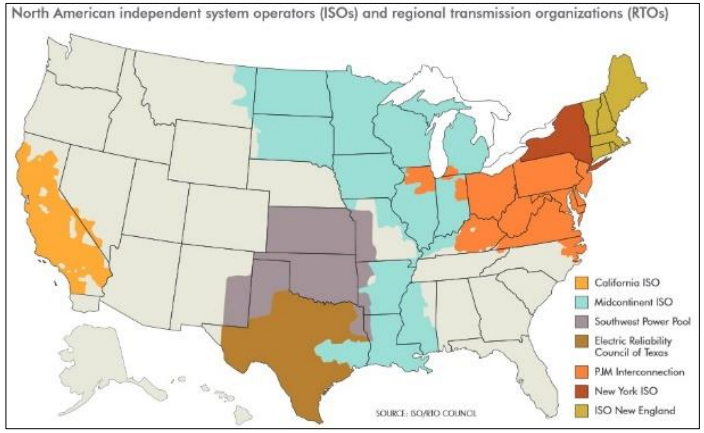
Energy Storage Markets Update

September 2015

The Clean Energy States Alliance, through its Energy Storage Technology Advancement Partnership (ESTAP), provides information and resources to support deployment of energy storage technologies. As part of that effort, this market brief presents information on the value of regional electric services markets in which energy storage can economically participate. The information presented here was originally presented in our webinar on September 30, 2015 that is available for review at www.cesa.org/webinars/estap-webinar-energy-storage-market-updates.

California (www.caiso.com): CAISO considers energy storage to be a non-generator resource (NGR) that is eligible to participate in both energy and ancillary services markets. Proxy Demand Response (PDR), a wholesale product, enables participation from behind the meter, although PDR resources cannot yet participate in the regulation market. Regulation is pay-for-performance with a market size of about 350MW (up and down), but prices continue to be low at $10-12/MW. Through its transmission planning process, CAISO has identified numerous ways that energy storage could alleviate reliability issues, and is developing new market rules for distributed resources including energy storage. CAISO plans to file a proposal with FERC to develop a new distributed resource energy provider category that can aggregate resources and offer both energy and ancillary services into the market. At the state level, energy storage can participate in CPUC's long- and short-term procurement programs. The short-term program, Resource Adequacy, is a 1-year forward bilateral capacity market offering compensation in a range of $1.50 to $3.50 per kW-month. CPUC is also working with CAISO to integrate DR into the wholesale market.

PJM (www.pjm.com): PJM has been forward-thinking on energy storage with an Advanced Technology Pilot Program, new asset classes (both energy storage and capacity resources), a fast-ramping and energy neutral regulation signal (RegD), the ability to manage state of charge by asset owner, and a Net Energy Settlement for storage at LMP. Minimum resource size to participate in PJM frequency regulation market is low at 0.1MW, and payments have been relatively high at about $40/MW/hour, including capability and performance prices. Market size is 650-700 effective MW, with about 176MW of grid-connected storage and about 5MW of behind the meter storage installed, which is classified as demand response (importantly, behind-the-meter demand response resources can only sell into the frequency regulation market up to the limit of their load size, as DR resources may not export power). PJM has a temporary cap on RegD volume, at 200-300MW, which will continue to be reviewed. Energy storage in PJM's capacity market follows a "reliability pricing model" with 3-year forward annual bidding process and payments of $150-200 per MW-d in the most recent auction; market size is about 167,000MW. There is no minimum duration requirement, but there is a check for reasonableness; if cleared as a capacity resource, there are obligations for services during certain hours and penalties for non-compliance. Storage can be aggregated with intermittent renewables, demand response, and energy efficiency as a single resource.



Federal Overview

Several FERC orders have helped integrate energy storage into the RTO and ISO markets.

Order 890 made clear that ancillary services could be provided by non-generation resources.

Order 719 created active participation by customers using demand response and **Order 745** established the payment structure.

Order 755 created new compensation rules for frequency regulation with a two-part payment structure including capacity and performance.

Order 784 allows energy storage owners to obtain the designation of market based rate authority and requires utilities to consider speed and accuracy of resources.

Order 794 changed how the amount of frequency response needed to maintain interconnection frequency is defined, including frequency response.

New England (www.iso-ne.com): ISONE created a testing environment for new technologies; passing the test allows participation alongside conventional resources in the regulation market. A new asset class, Alternative Technology Regulation Resource, has a minimum size of 1MW. There are a variety of net energy settlement options, including settlement at wholesale prices to avoid station charges. There are a variety of dispatch signals, including an energy neutral signal for limited-duration storage resources. ISONE regulation market is relatively small at about 60MW/hr. Resources are paid capacity and mileage, and mileage price is market-based; payment is affected by accuracy.

Texas: ERCOT (www.ercot.com): PUCT allows energy storage settlements at wholesale nodal price, though only a portion of the load at any plant can be eligible. It gave ERCOT the authority to conduct pilot products, including as a fast-responding regulation service (FRRS) that has now become a subset of normal regulation service, though it is currently limited to 65MW up and 35MW down; discussions are ongoing to raise this limit. ERCOT regulation market is about 500MW in size, with a minimum resource size of 0.1MW and separate products for Regulation Up and Regulation Down. The minimum resource size is relatively low at 0.1MW. FRRS must meet performance criteria, like automatically detecting frequency deviations to provide full response within 1 second. Limited duration resources are able to participate. Payment for FRRS is the same as normal regulation payments, with no pay-for-performance. ERCOT is talking about future ancillary services, and considering unbundling existing services, like their hybrid reserve product. Methods for procuring frequency response are under discussion.

Trends to Watch

Frequency response: FERC Order 794 rule BAL-003-1 is currently being implemented by RTOs.

A FERC NOPR regarding the sale of frequency response service at market-based rates will facilitate the sale of third-party FR and open the door to market-based sales.

Reactive Power: FERC docket AD14-7 is exploring compensation for reactive power.

Distributed Energy Resources: Rules are being developed for the integration of DER that can participate in wholesale markets from behind or in front of the meter.

Southwest Power Pool (www.spp.org): SPP has not yet created formal rules for energy storage resources, though this has been formally requested by a stakeholder and discussion will happen in Fall 2015. The regulation market is about 330MW in size with separate markets for Regulation up and down and a minimum resource size of 0.1MW. There are both capacity and mileage prices and payments, and these depend on accuracy.

Midcontinent (www.misoenergy.com): MISO created Stored Energy Resources (SER) as a resource type, allowing short-term storage devices (1 hour or less) to offer regulation with 5-minute state of charge management for any SER. Market size is about 400MW with a minimum resource size of 1MW. Payments include a capacity and mileage and resource revenue depends on accuracy and mileage. Net energy is settled at the wholesale price and excludes power station charges. The market is dispatched in five equal groups, with the first group having the fastest ramp rates; once this group is maxed out, remaining groups are dispatched sequentially. MISO is launching a new ramping product to be launched in 2016, though SER cannot currently provide this service.

New York (www.nyiso.com): NYISO created a new asset type called Limited Energy Storage Resource which allows short-duration resources to provide regulation with 5-minute state of charge management. Minimum regulation resource size is 1MW. The NYISO regulation market is about 215MW in size. Revenue depends on accuracy and mileage.

References

Energy Storage and Electricity Markets, by Clean Energy Group
http://bit.ly/Energy-Storage-Electricity-Markets

Webinar: Energy Storage and Electricity Markets
www.cesa.org/webinars/webinar-electricity-markets-and-the-economics-of-energy-storage

Webinar: Energy Storage in FERC Territories
www.cesa.org/webinars/clean-energy-group-webinar-energy-storage-in-ferc-territories

This is the second in a series of energy storage market updates from the Energy Storage Technology Advancement Partnership (ESTAP). ESTAP is managed by the Clean Energy States Alliance (CESA) with support from the U.S. Department of Energy Office of Electricity and Sandia National Laboratories. Learn more about ESTAP at www.cesa.org/projects/energy-storage-technology-advancement-partnership.

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This information was originally presented as a webinar in September 2015. Slides and a recording of this webinar are available at www.cesa.org/webinars/estap-webinar-energy-storage-market-updates.